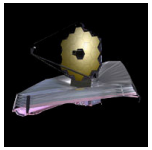

9483 - Pushing Little Red Dots to the Early Universe: Spectroscopic Confirmation of the First Robust z ~10 LRD Candidate

Cycle: 5, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Takumi Tanaka (PI)	**Kavli Inst for the Physics and Mathematics of the Universe**
Hollis Akins (CoI)	Princeton University
Dr. Yuichi Harikane (CoI)	University of Tokyo, Institute of Cosmic Ray Research
Dr. John David Silverman (CoI)	The Johns Hopkins University
Prof. Caitlin M. Casey (CoI) (US Admin CoI)	University of California - Santa Barbara
Dr. Kohei Inayoshi (CoI)	Peking University
Dr. Jan-Torge Schindler (CoI) (ESA Member)	Universitat Hamburg
Prof. Kazuhiro Shimasaku (CoI)	University of Tokyo
Prof. Dale D. Kocevski (CoI)	Colby College
Prof. Masafusa Onoue (CoI)	Waseda University
Dr. Andreas L Faisst (CoI)	California Institute of Technology
Prof. Brant Robertson (CoI)	University of California - Santa Cruz
Dr. Vasily Kokorev (CoI)	University of Texas at Austin
Dr. Marko Shuntov (CoI) (ESA Member)	Cosmic Dawn Center, Niels Bohr Institute
Dr. Anton M. Koekemoer (CoI)	Space Telescope Science Institute
Dr. Maximilien Franco (CoI) (ESA Member)	Universite Paris-Saclay
Dr. Daizhong Liu (CoI)	Purple Mountain Observatory, CAS
Dr. Anthony J. Taylor (CoI)	University of Texas at Austin
Dr. Jeyhan Kartaltepe (CoI)	Rochester Institute of Technology
Dr. Sarah E. I. Bosman (CoI) (ESA Member)	Universitat Heidelberg
Dr. Jaclyn Champagne (CoI)	Space Telescope Science Institute

Name	***Institution***
Dr. Koki Kakiichi (CoI) (ESA Member)	Cosmic Dawn Center, Niels Bohr Institute
Mr. Zijian Zhang (CoI)	Peking University
Sophie Newman (CoI) (ESA Member)	University of Portsmouth
Darshan Kakkad (CoI) (ESA Member)	University of Hertfordshire
Dr. Qinyue Fei (CoI) (CSA Member)	University of Toronto
Dr. Seiji Fujimoto (CoI) (CSA Member)	University of Toronto
Mingyu Li (CoI)	Tsinghua University
Prof. Steven L. Finkelstein (CoI)	University of Texas at Austin
Erini Lambrides (CoI)	NASA Goddard Space Flight Center
Laura Sommovigo (CoI)	Columbia University in the City of New York
Dr. Jorge Zavala (CoI)	University of Massachusetts - Amherst
Dr. Kei Ito (CoI) (ESA Member)	Technical University of Denmark-DTU Space
Mr. Zhaoxuan Liu (CoI)	Institute for Physics and Mathematics of the Universe
Dr. Ezequiel Treister (CoI)	Universidad de Tarapaca
Prof. Manuel Aravena (CoI)	Universidad Diego Portales
Dr. Ghassem Gozaliasl (CoI) (ESA Member)	Aalto University
Dr. Haowen Zhang (CoI) (CSA Member)	Canadian Institute for Theoretical Astrophysics
Mr. Hossein Eldin Hatamnia (CoI)	University of California - Riverside
Mr. Hiroya Umeda (CoI)	University of Tokyo, Graduate School of Science
Prof. Akio Inoue (CoI)	Waseda University
Dr. Jinyi Yang (CoI)	University of Michigan
Dr. Makoto Ando (CoI)	University of Tokyo, Institute of Cosmic Ray Research
Junya Arita (CoI)	University of Tokyo, Graduate School of Science
Prof. Xuheng Ding (CoI)	Wuhan University
Ms. Suin Matsui (CoI)	University of Tokyo, Institute of Astronomy
Yuki Shibanuma (CoI)	University of Tokyo, Institute of Astronomy
Prof. Georgios Magdis (CoI) (ESA Member)	Technical University of Denmark-DTU Space
Dr. Mingyang Zhuang (CoI)	University of Illinois at Urbana - Champaign
Prof. Xiaohui Fan (CoI)	University of Arizona
Mr. Zihao Li (CoI) (ESA Member)	University of Copenhagen, Niels Bohr Institute
Weizhe Liu (CoI)	University of Arizona
Dr. Jianwei Lyu (CoI)	University of Arizona

Name	***Institution***
Dr. Jason D. Rhodes (CoI)	Jet Propulsion Laboratory
Prof. Sune Toft (CoI) (ESA Member)	University of Copenhagen, Niels Bohr Institute
Dr. Feige Wang (CoI)	University of Michigan
Dr. Siwei Zou (CoI)	Universidad de Chile
Rafael Claudino Arango Toro (CoI) (ESA Member)	CNRS, Laboratoire d'Astrophysique de Marseille
Dr. Andrew J. Battisti (CoI)	University of Western Australia
Dr. Steven Richard Gillman (CoI) (ESA Member)	Technical University of Denmark-DTU Space
Dr. Ali Ahmad Khostovan (CoI)	University of Kentucky
Prof. Arianna Long (CoI)	University of Washington
Timothy M. Heckman (CoI)	The Johns Hopkins University
Maria Pudoka (CoI)	University of Arizona
Dr. Eiichi Egami (CoI)	University of Arizona
Dr. Jed McKinney (CoI)	University of Texas at Austin
Mr. Zijian Li (CoI)	National Astronomical Observatories of China (NAOC)
Prof. David B. Sanders (CoI)	University of Hawaii
Dr. Bahram Mobasher (CoI)	University of California - Riverside
Prof. Benny Trakhtenbrot (CoI)	Tel Aviv University - Wise Observatory
Yiyang Zhang (CoI)	Wuhan University
Mr. Ronaldo Laishram (CoI)	National Astronomical Observatory of Japan (NAOJ)
Dr. Santosh Harish (CoI)	Space Telescope Science Institute
Dr. Knud Jahnke (CoI) (ESA Member)	Max Planck Institute for Astronomy
Mr. Zeyu Gao (CoI)	Peking University
Mr. Tomokazu Kiyota (CoI)	National Astronomical Observatory of Japan (NAOJ)
Dr. Wuji Wang (CoI)	California Institute of Technology
Dr. Yongming Liang (CoI)	University of Tokyo, Institute of Cosmic Ray Research
Dr. Mitsuru Kokubo (CoI)	National Astronomical Observatory of Japan (NAOJ)
Dr. Irham Andika (CoI) (ESA Member)	Ludwig Maximilian Universitat of Munich
Dr. Marc Huertas-Company (CoI) (ESA Member)	Instituto de Astrofisica de Canarias
Dr. Aswin Payyoor Vijayan (CoI) (ESA Member)	Technical University of Denmark-DTU Space
Dr. Gabriel Brammer (CoI) (ESA Member)	University of Copenhagen, Niels Bohr Institute
Dr. Fengwu Sun (CoI)	Harvard University

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	MIRI LRS-1	MIRI Low Resolution Spectroscopy	(1) CW-LRD-z10
	2	MIRI LRS-2	MIRI Low Resolution Spectroscopy	(1) CW-LRD-z10
	3	MIRI LRS-3	MIRI Low Resolution Spectroscopy	(1) CW-LRD-z10

ABSTRACT

JWST observations have revealed a new population of compact, high-z objects called “little red dots” (LRDs), attracting attention for their potential role in early supermassive black hole (SMBH) and galaxy formation. We propose MIRI/LRS slit spectroscopy of CW-LRD-z10, the first robust candidate of a z>10 LRD, identified through a novel joint MIRI+NIRCam color selection in the COSMOS-Web field. With this Very Small program, we will (1) spectroscopically confirm the redshift with multiple emission lines (Hbeta+[OIII] and Halpha) and (2) test its LRD nature via detection of continuum emission. If spectroscopically confirmed to indeed be the first z>10 LRD, CW-LRD-z10 will represent the most distant LRD and one of the most distant SMBHs discovered to date, providing critical constraints on SMBH formation in the early Universe. Furthermore, we will put the first spectroscopic constraint on the number density of LRDs at z~10, suggesting that the relative abundance of LRDs may increase toward higher-z compared to non-LRD galaxies. This would imply that LRDs also represent a key population for understanding the early Universe itself. Even if confirmed not to be an LRD, the observed photometry suggests the presence of an exceptionally intense Halpha emission line, stronger than theoretical prediction, still making it a groundbreaking discovery that challenges our physical understanding of high-z galaxies. Finally, the outcome of this observation will highlight the importance of expanding MIRI surveys and follow-up observations to identify more z>10 LRDs, affecting community-wide strategies in future JWST cycles for probing the early growth of SMBHs.

OBSERVING DESCRIPTION

Given the need for high sensitivity to detect continuum in the mid-infrared, we employ MIRI/LRS slit spectroscopy with a low background level (<20th percentile above minimum). A nearby field star confirmed with the SIMBAD database is used for TA, and the verification image will be taken for positining verification as recommended for LRS slit spectroscopy. The target is a compact point-like source, so we adopt the ALONG SLIT NOD dither pattern. With this dither type, additional dedicated background observations are not required. The total integration time is set to 13.4 hours (on source), sufficient to achieve:

(1) detections of the Halpha and Hbeta+[OIII] emission lines with the peak S/N of 23 and 9, respectively.

(2) detection of the binned continuum at ~6-12 um with S/N>5, critical to confirm the steep red continuum characteristic for LRDs.

The target is observable with the low-level background in two windows of Cycle 5: [19 December 2026 - 7 January 2027] and [6 - 24 April 2027]. Within these windows, there is no preference for the observation schedule, although the earlier window would allow more rapid progress in this rapidly evolving field.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CW-LRD-z10	RA: 10 00 20.1836 (150.0840983d) Dec: +02 27 14.02 (2.45389d) Equinox: J2000		
Comments: The z~10 LRD candidate in COSMOS-Web (Tanaka+25) *Category=Galaxy* *Description=[Active galactic nuclei, High-redshift galaxies]* *Extended=NO*				
(2)	TA_star_COSMOS_1962561	RA: 10 00 20.0056 (150.0833567d) Dec: +02 27 3.03 (2.45084d) Equinox: J2000	Proper Motion RA: -2.471 mas/yr Proper Motion Dec: -34.23199991630099 mas/yr Parallax: 5.078E-4" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.* *Category=Star* *Description=[G stars]* *Extended=NO*				

Observation

Proposal 9483, Observation 1: MIRI LRS-1

Wed May 20 20:00:24 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CW-LRD-z10	RA: 10 00 20.1836 (150.0840983d) Dec: +02 27 14.02 (2.45389d) Equinox: J2000		

Comments: The z~10 LRD candidate in COSMOS-Web (Tanaka+25)
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	2 TA_star_COSMOS_1 962561	F560W	FASTGRPAVG	6	1	1	66.601	261220.8

Template

Subarray	Obtain Verification Image?
FULL	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	ALONG SLIT NOD				

Pointing Verification

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	Optional ETC ID	Filter
1	FASTR1	33	13	13	1	1	1223.793		F770W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	Optional ETC ID
1	FASTR1	90	32	64	1	2	16156.283	261220.2

Special Requirements

Background Limited. Background no more than 20th percentile above minimum

Observation

Proposal 9483, Observation 2: MIRI LRS-2

Wed May 20 20:00:24 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CW-LRD-z10	RA: 10 00 20.1836 (150.0840983d) Dec: +02 27 14.02 (2.45389d) Equinox: J2000		

Comments: The z~10 LRD candidate in COSMOS-Web (Tanaka+25)
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	2 TA_star_COSMOS_1 962561	F560W	FASTGRPAVG	6	1	1	66.601	261220.8

Template

Subarray	Obtain Verification Image?
FULL	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	ALONG SLIT NOD				

Pointing Verification

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	Optional ETC ID	Filter
1	FASTR1	33	13	13	1	1	1223.793		F770W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	Optional ETC ID
1	FASTR1	90	32	64	1	2	16156.283	261220.2

Special Requirements

Background Limited. Background no more than 20th percentile above minimum

Observation

Proposal 9483, Observation 3: MIRI LRS-3 Wed May 20 20:00:24 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CW-LRD-z10	RA: 10 00 20.1836 (150.0840983d) Dec: +02 27 14.02 (2.45389d) Equinox: J2000		

Comments: The z~10 LRD candidate in COSMOS-Web (Tanaka+25)
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	2 TA_star_COSMOS_1 962561	F560W	FASTGRPAVG	6	1	1	66.601	261220.8

Template

Subarray	Obtain Verification Image?
FULL	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	ALONG SLIT NOD				

Pointing Verification

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	Optional ETC ID	Filter
1	FASTR1	33	13	13	1	1	1223.793		F770W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	Optional ETC ID
1	FASTR1	90	32	64	1	2	16156.283	261220.2

Special Requirements

Background Limited. Background no more than 20th percentile above minimum